BeAGLE Status and Plans

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Big Picture & Main issues

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EIC R&D Meeting

- Asked for full occupancy (0.45 FTE = old EICR&D + JLAB LDRD) as in FY2017-19, but all from EIC R&D.
- Went very well. They recommended: "Full support ... during FY21".
- Thanks for all the advice and support!

Key benchmarks

with advice from the YR diffraction and tagging WG.
Important physics, challenging to the detector.

Benchmark e+A processes for Detector/IR optimization using BeAGLE (or BeAGLE + GCF)

Incoherent diffractive V = (J/ψ or ϕ) production:	
$e + Pb \rightarrow e' + V + X$	**veto tagging for coherent diff. (G distribution and saturation)**
$e + Pb \rightarrow e' + J/\psi + X$	comparison to e+D or e+p for nucleon "shape" studies in nuclei
$e + Pb \rightarrow e' + J/\psi + X$	geometry tagging for nucleon "shape" studies in nuclei
Short-range correlation studies A = (C or Pb e.g.):	
$e + D \rightarrow e' + J/\psi + n + p$	**Kinematically tagged deuteron tail (SRC) studies any x**
$e + C \rightarrow e' + J/\psi + (NN)_{SRC} + X$	Kinematically tagged SRC correlation studies at any x
$e + D \rightarrow e' + n + p$	Quasi-elastic deuteron studies
$e + C \rightarrow e' + (NN)_{SRC} + X$	Quasi-elastic SRC studies [higher Q^2]
$e + A \rightarrow e' + (NN)_{SRC} + X$	**SRC-tagged DIS studies in EMC region 0.2<x<0.8**
$e + A \rightarrow e' + X$ w/ SRC veto	**SRC-vetoed DIS studies in EMC region 0.2<x<0.8**
Quasi-neutron DIS with proton spectators:	
$e + D \rightarrow e' + p + X$	Measure quasi-free neutron structure function
$e + D \rightarrow e' + n + X$	Isospin inverse to confirm that proton SF extraction works
$e + {}^3He \rightarrow e' + p + p + X$	**Access to neutron spin structure function**
$e + {}^3H \rightarrow e' + n + n + X$	Isospin inverse to confirm spin proton SF extraction
Geometry tagged DIS:	
$e + Pb \rightarrow e' + X$	

Simple coding issues

- Straighten out 4-momentum conservation
- Start with simplest systems:
  - GCF-QE – simplest system. Needed for GCF-DIS.
  - e+D – Probably a disconnect between Baker/Tu code.
  - e+^{3}He – DPMJET confused by (pp) remant A=Z=2 "nucleus".
- Hopefully this will fix it all, but other processes need checking too...
- Also chase down some compiler warnings as suggested by Kolja!

What does $\Delta y=0.6$ mean at the EIC?

- $P_z = m \sinh y \sim m e^{y}/2$
- P_z changes by a factor of $e^{\Delta y}$, $e^{0.6}=1.8$
- P_z of "INC" is decreased by a factor 1.8
- θ of "INC" is increased by a factor 1.8

- Most problematic for estimates of veto-tagging of coherent diffraction.

How to proceed?

- Ideally would like a good model for the nuclear response particles instead of simple "INC".
  - PyQM with nucleonic absorption of soft gluons?
  - Nucleonic absorption of
  - INC with a different approach than simple "formation time"?
  - Inelastic multinucleon shadowing (i.e. scattering from more than one nucleon) (genShd=4?)
  - Argantyr?

How to proceed?

- Realistically, I may have to just hack it.
  - Shift INC by $\Delta y=0.6$
  - Steal 4-momentum from other particles to compensate.
- Concerns
  - Different models are different!
    - E.g. PyQM gluon absorption would predict very little extra particle production in diffractive events while inelastic multinucleon shadowing would be strongest in diffractive events...
  - One bit of E665 data driving everything.
    - Kong + Michael Murray pursuing CMS p+Pb UPC?

Applying BeAGLE to CMS p+Pb UPC

- Idea is to run e+Pb and weight by ratio of flux factors in Q^2,y or whatever.
- This was done by ATLAS for Pb+Pb UPC and Pythia, but without the nuclear response part of things.
- I don't understand how to handle the fact that for BeAGLE we need $Q^2>1GeV^2$.

Benchmarks & Status/Plans

- $e + D \rightarrow e' + J/\psi + n + p$
  - Fix small momentum non-conservation
  - Add off-shell structure functions (Kong)
- $e + Pb \rightarrow e' + V + X$ (diffractive veto)
  - Understand INC using E665 (DIS) data (& LHC p+A UPC?) & tune or hack if possible.
- $e+A \rightarrow e' +(NN)_{SRC} +X$
  - Upgrade BeAGLE to handle this.
- $e + {}^3He \rightarrow e' + p + p + X$
  - Debug ^{3}He in DPMJET-F & fix Fermi motion

Fermi motion problem for ^{3}He

- Standard procedure:
  - Roll A nucleons according to 1-particle p distribution.
  - Subtract p_{tot}/A from each nucleon to recenter at p_{tot}=0. BUT THIS CHANGES 1-particle p dist.!
- For Pb or Au, this effect is small.
- For D there is no problem. Roll 1 and the other is equal and opposite. Interpret "k" correctly.
- For A=3, it's pretty bad... Should have a 3-particle distribution which projects to the correct 1-particle distribution...

Additional tasks

- I also owe Wan 1M events...
- Papers??